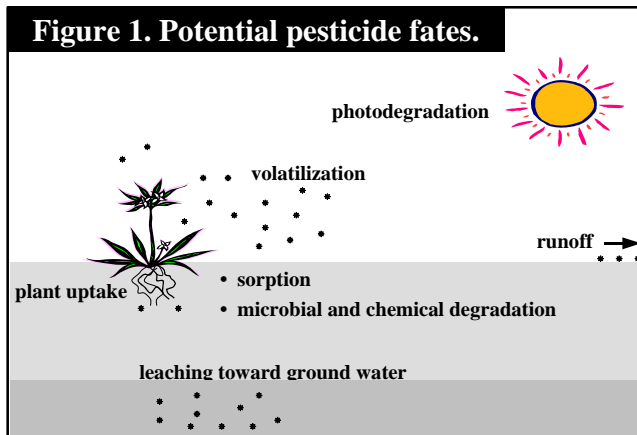


# Soil Organic Matter and How it Affects Pesticide Leaching to Ground Water



Once a pesticide is applied to a soil there are three main fate processes that may take place: 1) the pesticide may be sorbed (or bound) to soil particles; 2) the pesticide may be transferred through volatilization, runoff, leaching, or uptake by plant material; or 3) the pesticide may degrade or break down by means of photo degradation, microbial degradation, or chemical degradation (Figure 1).

The role of soil organic matter (SOM) in sorbing or binding pesticides is one of the most important soil properties affecting a pesticides ability to leach into ground water. SOM is comprised of an accumulation of partially decomposed plant and animal residues as well as organic compounds synthesized by soil microbes. SOM has a great number of binding sites because it has an extremely large surface area and is chemically reactive. Because SOM has a high sorption capacity (also known as a high cation exchange capacity or CEC), pesticides and other organic compounds are readily attached to organic soil particles. Once sorbed to SOM the pesticides are not readily available to dissolve into soil water and leach towards ground water. In addition to the sorption potential of SOM, higher quantities of SOM generally indicate higher rates of microbial activity in the soil, and thus the greater potential for microbial degradation of the pesticide before it is able to leach down towards ground water.



The inclination of a pesticide to be sorbed to soil particles as opposed to being dissolved in soil water is called the partition coefficient ( $K_d$ ).  $K_d$  is equal to the concentration of a pesticide in soil ( $\mu\text{g/kg}$ ) divided by its concentration in soil water ( $\mu\text{g/L}$ ). A higher  $K_d$  value indicates that the pesticide will be more strongly sorbed to soil particles and that there will be less pesticide in solution. However, the  $K_d$  of a pesticide will vary from one soil to another because of the physical and chemical properties of the soil and is not a good indicator of a pesticides mobility in the soil environment. Therefore, a different number, the sorption coefficient ( $K_{oc}$ ), is more often used to determine a pesticide's mobility in soils. The  $K_{oc}$  is equal to the partition coefficient divided by the amount of organic carbon in the soil (organic carbon is a quantitative measure of a soils organic matter content). The higher the  $K_{oc}$  the more strongly the pesticide is sorbed to the soil particles, and therefore, the less mobile it is. In other words, a greater amount of SOM means there is more pesticide bound to soil particles and less pesticide in solution, and thus, there is a lower probability that the pesticide will leach and impact ground water.

In general, fine-textured soils (silts and clays) have higher quantities of SOM and thus, a higher sorption potential, while coarse-textured soils (sandy) have lower quantities of SOM and a lower sorption potential. SOM may be one the most important soil properties that affects pesticide leaching, but it is not the only one. The texture and permeability of the soil are two others. The texture of a soil refers to the relative proportions of sand, silt, and clay while the permeability refers to the ability of water to move through a soil. Leaching is much more likely in a highly permeable sandy soil with low SOM then it is with a slightly permeable fine or clay rich soil with high SOM.

## Best Management Practices for Managing Soil Organic Matter:

- 1) Crop rotations that include diverse high biomass crops
- 2) Reducing tillage
- 3) The use of green manure
- 4) Growing cover crops
- 5) Leaving crop residue on the soil surface
- 6) Reducing the use of summer fallow

Educational materials for improving your soil organic matter along with numerous other agricultural topics can be obtained from the Montana State University (MSU) Extension Service (<http://www.montana.edu/wwwpb/pubs/indexag.html>) or contact your MSU County Extension Agent).

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